PATENT SPECIFICATION

(11) 1 381 114

1 381 114

(21) Application No. 18324/71 (22) Filed 1 June 1971

(23) Complete Specification filed 31 May 1972

(44) Complete Specification published 22 Jan. 1975

(51) INT. CL[3] F16H 21/10

(52) Index at acceptance
F2K 4B6

(54) MECHANICAL TRANSMISSION COUPLING TO TRANSMIT RECTILINEAR FORCE AND MOVEMENT

(71) I DAVID THOMAS CODD a British Subject, of 12, Thorncliffe Road, Oxford, do hereby declare the invention, for which I pray that a patent may be granted to me, and the method by which it is to be performed, to be particularly described in and by the following statement:

This invention relates to a mechanical transmission Coupling to effect transmission of force and or rectilinear mechanical movement, from an external driving machine element (or the like) acting along a rectilinear axis, to force and or rectilinear mechanical movement of other single or multiple machine element or elements (or the like) acting along other rectilinear axes, individually crossing the axis of rectilinear movement of the driving machine element and displaced from it by fixed chosen angular relationship or relationships.

According to this present invention there are provided one or a number of driving rigid members with suitable means of connection to the driving machine element (or the like) and one or a number of reacting driven rigid members with suitable means of connection to other machine element or elements (or the like), individually or severally constrained by suitable guiding means to rectilinear movement along axes aligned with the axes of rectilinear movement of the machine elements (or the like) to which the members are to be connected respectively, each of the driving and driven rigid members having one or a number of discrete flat faces parallel with the rectilinear axis of movement of the member and being provided with a plurality of straight parallel diagonal ridges or tooth-like projections formed in or projecting from one or more of those faces and longitudinally inclined to and extending along that face for a chosen distance in the direction of the rectilinear axis of that member, such that when the driving and driven members are constrained by the guiding means, the ridges or tooth-like projections provided on a face or on faces of a driving member, severally and sequentially engage in slidable contact the ridges or tooth-like projections provided on a face of reacting driven members as movement progresses, to thereby impart through the flanks of the ridges or tooth-like projections of the driving member to the flanks of the ridges or tooth-like projections of the driven member meshed with it, components of force and or rectilinear movement. The angle of inclination of the ridges or tooth-like projections of the driven member to its axis of rectilinear movement is of necessity the supplement of the angle subtended between the axes of rectilinear movement of the driving and the driven members in meshed engagement, and the chosen angle of inclination of the ridges or tooth-like projections of the driving member face involved to the axis of rectilinear movement of the driving member. The angle of inclination of the ridges or tooth-like projections provided on a face of a driving member to its axis of rectilinear movement is such as to satisfy a chosen proportional force and or rectilinear movement imparted to a driven machine element (or the like) acted upon by the driven member connected to it and the angle subtended between the axes of the rectilinear movement of the driving and the driven members in meshed engagement. Suitable means of connection of the members to their respective machine elements (or the like) are provided in the form of any modification to the lateral extremities of the members or extension of the members along their axes of rectilinear movement beyond the active meshing areas such as internal or external threads (or the like), profiles,

[*Price 33p*]

crossholes (or the like) or by frictional clamping of the member to a part of the machine element (or the like); or in the case of driven member only required to impart thrust force or rectilinear movement to a machine element (or the like) in a direction outward from the axis of rectilinear movement of the driving member, suitable means of connection is provided by contact only.

The ridges or tooth-like projections provided on faces of the members are either formed integrally with the member or may be additional and attached to the member by suitable means or in the case of one member of any coacting pair of driving and driven members, may be in the form of anti-friction devices such as: freely rotatable wheels or rollers, recirculating ball or roller units, linear bearing elements or assemblies or the like. Suitable means of attachment of additional elements to provide the function of the ridges or tooth-like projections on a face of a member is by such means as: keying, socketing, pinning, screwing or the like, or by welding or the like, or by casting or electrodeposition or by any combination of the foregoing means. Suitable means of attachment of anti-friction devices to provide the function of the ridges or tooth-like projections of a member, is either by similar means as for the attachment of other additional elements providing the same function, or by their application to integrally formed ridges or tooth-like projections or to bosses or other projections from the face of the member.

The guiding means to constrain the members to their respective rectilinear movements, is provided by single or multiple guides, singly, conjointly or severally connected by suitable means to a machine element or to machine elements (or the like) which is or are respectively, static in relation to the axes of rectilinear movement of the members in meshed engagement, acting in slidable contact with internal or external surfaces of the respective member, which surfaces are parallel with the axis of rectilinear movement of that member. The guiding means and or the guided surfaces of the members in slidable contact with each-other are either single or multiple surfaces of chosen lengths disposed lengthwise parallel with the axes of rectilinear movement of the guided members, or there may also be provided intermediate guiding means between the guiding and the guided members such as: linear ball or roller races, slidable bars, bushes, sleeves or keys (or the like); or either the guiding or guided member may be equiped with anti-friction devices such as: wheels, ball races, rollers or the like, or any combination of the foregoing means (as befits the application of the device) to constrain the members to be guided, in one or a number of directions normal to their respective axes of rectilinear movement.

Additionally according to this invention, the members in meshed engagement may be arranged to operate in compound trains, such that the first driven members (for example) have additional faces provided with ridges or tooth-like projections similar to those of a driving member, to engage in mesh ridges or tooth-like projections of a subsequent member, so that the first above mentioned member becomes intermediate between the driving member in meshed engagement with it and the subsequent member driven by it. It will be understood, that further members may be driven by the above mentioned subsequent member etc, thus providing a form of linear gearing, which could have applications to locking, clamping or similar operations. In each case, these additional members are guided by similar means as those described in relation to the guiding means for driving and driven members.

In a preferred arrangement of this invention, the guiding means for driving and driven members in meshed engagement, comprises one or a number of separate or conjoint blocks grooved with channels aligned with the axes of rectilinear movement of the members to be guided, and of suitable size and shape and position, to guide in slidable contact one or a number of pairs of members in meshed engagement, each such member being individually of substantially uniform cross section normal to its axis of rectilinear movement. Each of the driving and driven members is provided with ridges or tooth-like projections on one or more faces as previously described, which are suitable to slide on the guiding faces of the channel for it within the guiding block or blocks, and to mesh with its selected mating member or members. The guiding block or blocks preferably incorporate means (holes, keyways, projections or the like) for the attachment of the guiding means to a machine element or to machine elements (or the like) which is or are, respectively, static in relation to the axes of rectilinear of the driving and driven machine elements (or the like) and thus afford a means of force reaction whereby force and or rectilinear movement may be transmitted.

In a further preferred arrangement of this invention, the guiding blocks and driven members described in the preceding preferred arrangement, are provided with coacting detent means such as: ball catch and socket, roller spring and socket, magnet and bar etc; where one element of the coacting detent means is located in the

guiding block and the other element is in the driven member, to secure the driven member in such a position in relation to the channel of the guiding block for the driving member, that the ridges or tooth-like projections of that driving member, may engage in mesh the ridges or tooth-like projections of the driven member without additional adjustment to the position of that driven member.

In an additional preferred arrangement of this invention, the guiding blocks and driving members described before, are provided with coacting detent means similar in all respects to the detent means as applied to driven members, as described in the further preferred arrangement above.

In another preferred arrangement of this invention, the driving and driven members are provided with suitable means to arrest travel of the member at chosen limiting positions in one or both directions of rectilinear movement. In one convenient arrangement the means of effecting the arrest of travel of a member, is that the member is provided with an increase in its cross section normal to its axis of rectilinear movement, to abut a part of the guiding block or a part of the member with which is in meshed engagement at the limiting position of travel. In another convenient arrangement, the arresting means is provided by an attachment to the member secured by suitable means, at the position to effect the limit of travel chosen. Suitable means of attachment of the arresting means is provided by screw fixing, pinning, frictional clamping or the like as befits the application. In a further convenient arrangement, the travel limiting means is provided with suitable means to effect fine adjustment of the limiting position. Suitable means of fine adjustment of the limiting position of travel, is provided by an adjusting screw axially aligned with the member and either attached to that member or to the guiding block. Alternative suitable means of fine adjustment are provided by an eccentric or cam (or the like) attached to either the member or to the guiding block or both. In an additional convenient means to limit travel of a member, there is provided an obstruction within the meshing face of the mated member, to the movement of the ridges or tooth-like projections of the member beyond the limiting position of travel.

There will follow by way of example, a description of one embodiment of the device according to this invention, with reference to the accompanying drawings:

Figure: 1 is a perspective view of the device seen from the side of the guide-block containing the guiding groove for the driven member, with hidden details of both members and a detent system applied to the driven member shown by broken lines.

Figure: 2 is a typical cross-section of both members normal to their respective axes of rectilinear movement.

Figure: 3 is an orthometric plan view of the device seen from the side containing the guiding-groove for the driving member, with hidden details of the members shown by broken lines. This figure also includes a vector diagram to illustrate the relationship of rectilinear movement of the driving and driven members, and the angle of inclination of the ridges or tooth-like projection on their meshing faces.

Figure: 4 is a section through the device taken on the line IV-IV on Figure: 3 and shows the ridges or tooth-like projections of the driving and driven members in meshed engagement and the members constrained to that engagement by the guide-block.

Figure: 5 is a section through the device taken on the line V-V on Figure: 1 and shows the detent system operating on the driven member which has been adjusted to the detent position.

In this embodiment of the device according to this invention, there are provided one each of a driving rigid member 1 and a driven rigid member 2, both of which are constrained by a guide-block 3 to sliding rectilinear travel along their respective axes of rectilinear movement and angularly displaced from each other by a right angle, as shown in Figure: 3.

Both the driving member 1 and the driven member 2 are of uniform cross-section normal to their respective axes of rectilinear movement throughout their mutually meshing active lengths, as shown in Figure: 2, having one wider face 4 and one parallel narrower face 5, two narrow parallel edges 6 and two completing angled faces 7 either side of face 5.

Face 4 of each of the members 1 & 2, is provided with a number of ridges or tooth-like projections 8 inclined obliquely across face 4, at an angle A in the case of the driving member 1 and at an angle 90°-A in the case of the driven member 2, the angles in both cases being taken in reference to edges 6 of each member respectively.

The ridges or tooth-like projections 8 of both the driving member 1 and the driven member 2, are all of equal, uniform and rectangular cross-section as shown in Figure: 4 parallel with each other and equi-spaced from each other by a distance very slightly greater than their width so as to provide freedom for them to mesh and move in mutually sliding contact, with those of their mating member.

At one end of each of the members 1 & 2, the thickness normal to face 4 is abruptly increased to the same thickness as that of

the guide-block 3, to form the rectangular boss 9 and provide a locality for the threaded hole 10 which is to serve as means of attachment of the member to its respective external machine element. The abrupt increase in thickness of each member to form the boss 9, also gives rise to faces 11 normal to faces 4, to provide means to limit inward travel of the member by arrest of faces 11 against the side of the guide-block 3, to which later reference is made.

Guide-block 3 consists of a rectangular block of width and length greater than its thickness and greater than the width of the guided members 1 & 2 as is shown in Figures: 1 & 3, which is grooved from side to side across the two opposite faces 12 & 13 with dove-tail interconnecting guiding grooves 14 & 15 respectively, angularly disposed at right-angles to each other, and of uniform cross-section normal to their sides and of slightly larger size than the cross-section of the driving and driven members 1 & 2 respectively as shown in Figure: 2, to constrain those members to sliding contact within them on faces 4, edges 6 and angled faces 7. The depth of interpenetration of the two guiding-grooves 14 & 15 being such that the ridges or tooth-like projections 8 of the guided members 1 & 2 are brought into and maintained in meshing engagement as is shown in Figure: 4 at slightly less than full depth engagement to allow freedom for the tops of the ridges or tooth-like projections 8 to slide without interference.

The guide-block 3 is provided with threaded holes 16 in faces 12 & 13 and in the side normal to the driven member 2 in the direction of its enlarged end as is shown in Figure: 1, by which it may be connected to a machine element suitable to accept the force reaction and thrust of the driving member 1 and of the driven member 2 acting-on or acted-upon by their respectively connected machine elements.

Face 11 on the driven member 2, is so positioned that when it is in contact with the side of the guide-block 3 to prevent further inward travel of that member, the driving member 1 is at the immediate point of meshing engagement with the driven member 2, or of disengagement from it; such that with inward movement of the driving member 1, engagement of the ridges or tooth-like projections 8 of both members would result in the transmission of force and or rectilinear movement from the driving member 1 to the driven member 2; while with outward travel of the driving member 1, that member could be withdrawn from its guiding-groove 14 in the guide-block 3 without any directly consequential effect on the driven member 2.

The driven member 2 is resiliently restrained at its position of maximum inward travel, to maintain that position for the re-engagement of the driving member 1, by a detent system of known kind as is shown in Figure: 5 in which detent-ball 17 is guided in a hole normal to the guiding-groove 15 in guide-block 3 and is urged towards one of the faces 7 of the driven member 2 by spring 18 which is secured and loaded by the hollow screw 19. A shallow depression 20 in the co-operating face 7 of the driven member 2, is suitably sized and positioned to receive detent-ball 17 and to prevent travel of the driven member 2 until the resilient force exerted by spring 18 is overcome, thereby to retain under that limiting condition, the driven member 2 in the correct position for re-engagement by the driving member 1. To facilitate its re-entry into the guide-block 3 in guiding-groove 14, the corners of end 21 of the driving member 1 are suitably radiused. Movement of the driven member 2 resultant from sufficient force transmitted from the driving member 1 on re-engagement, to overcome the resilient force of spring 18, causes the detent-ball 17 to become unseated from the shallow depression 20. It being understood, that the force transmitted from the driving member 1, is that imparted to it by the driving machine element (or the like) to which it is connected.

In a suitable application of the device as described in the foregoing description of one embodiment of the device, the external driving machine element to which the driving member 1 might be connected, would be the injection-side of a splittable injection-moulding die (or the like); in which case, the guide-block would be attached to the other side of the same and the external driven machine element would be a side-core or the like.

WHAT I CLAIM IS:

1. A mechanical transmission coupling to transmit force and or rectilinear movement from firstly moving or movable driving to secondly movable driven external machine elements, in which transmission a change of rectilinear direction and or mechanical advantage is involved, in which there are provided firstly connectable driving and secondly connectable driven rectilinear movable members, where each such member comprises a rack-like plurality of tooth-like projections inclined to the rectilinear directions of movement of the respective member, and each such driving and driven member is guided by fixed guiding means so that its movements are confined to the rectilinear directions of movement of its respectively connectable external machine element, whilst the tooth-like projections of pairs of driving and driven members are severally,

sequentially and mutually engaged in mesh as movement progresses.

2. A mechanical transmission coupling according to claim 1, in which the transmission of force and or rectilinear movement is accomplished by means of intermediate additional rectilinearly movable members between driving and driven members, where each such intermediate member comprises a rack-like plurality of tooth-like projections inclined to the directions of rectilinear movement of the respective member and each is guided by fixed guiding means so that its movements are confined to a rectilinear direction between that of the member which drives it and that of the member driven by it, whilst the tooth-like projections of pairs of driving and intermediate members and those of pairs of intermediate and driven members, are severally sequentially and mutually engaged in mesh as movement progresses.

3. A mechanical transmission coupling according to claim 1, in which a train of intermediate and additional rectilinearly movable members is interposed between driving and driven members, where each such intermediate member comprises a rack-like plurality of tooth-like projections inclined to the rectilinear directions of movements of the respective member, such that force and or rectilinear movement is transmitted from driving members to intermediate members first in a train and then successively from intermediate members to intermediate members next in a train or and finally to driven members, whilst the tooth-like projections of the severally meshed pairs of members are severally, sequentially and mutually engaged in mesh as movement progresses.

4. A mechanical transmission coupling according to claims 1, 2 or 3, in which a driving member or an intermediate member forms a plurality of meshed pairs with a plurality of intermediate members or with a plurality of driven members.

5. A mechanical transmission coupling according to claims 1, 2 or 3, in which a plurality of driving members or a plurality of intermediate members, form a plurality of meshed pairs with an intermediate member or a driven member.

6. A mechanical tranmsission coupling according to any of the claims 1 to 5 inclusive, in which a member is of rigid bar like form.

7. A mechanical transmission coupling according to any of the claims 1 to 5 inclusive, in which a member is a rigid assembly of parts.

8. A mechanical transmission coupling according to claims 6 or 7, in which a member has internal and or external surfaces which are parallel with its directions of rectilinear movements, by which it may be guided by the guiding means.

9. A mechanical transmission coupling according to claim 8, in which driving and driven members have means for connection to external machine elements, such as: a threaded or plain hole or the like, a groove or slot or the like, a pin or projecting boss or key or an enlargement of the section of the member or the like, a plurality of any of the foregoing examples either singly or in any combination or any other known methods including the provision for welding or brazing or the like.

10. A mechanical transmission coupling according to claims 8 or 9, in which a member has a face equipped with a plurality of regular tooth-like projections, the roots and crests of which projections lie on two seperate planes parallel with each other and the directions of rectilinear movement of the member, through the side flanks of which projections, force and or rectilinear movement is transmitted by means of meshing engagement with the tooth-like projections of another member.

11. A mechanical transmission coupling according to claim 10, in which a member has a plurality of faces equipped with tooth-like projections as described in claim 10, through the side flanks of which projections, force and or rectilinear movement is transmitted by means of meshing engagement with the tooth-like projections of other members.

12. A mechanical transmission coupling according to claims 10 or 11, in which the side flanks of the tooth-like projections are uniformally inclined to the rectilinear directions of movement of that member.

13. A mechanical transmission coupling according to claim 12, in which the tooth-like projections on a face of a member are of uniform opposite flank to flank width.

14. A mechanical transmission coupling according to claims 12 & 13, in which adjacent tooth-like projections on a face of a member are equispaced from each other.

15. A mechanical transmission coupling according to claim 14, in which known friction reducing means, such as for example: rollers, balls, linear ball or roller races, recirculating ball units or the like, are interposed between the flanks of tooth-like projections of members in meshing engagement.

16. A mechanical transmission coupling according to claim 14, in which known friction reducing means, such as cylindrical ball or roller races, wheels, linear ball or roller races or the like, replace the ridges or tooth-like projections of one member of a pair of members in meshing engagement.

17. A mechanical transmission coupling according to any of the claims 1 to 16 in-

clusive, in which the guiding means is provided with a hole or channel or groove or the like, an internal surface of which guides a member by sliding contact with an external surface of that member.

18. A mechanical transmission coupling according to any of the claims 1 to 17 inclusive, in which the guiding means is provided with an external surface by which a member may be guided by an internal surface of that member.

19. A mechanical transmission coupling according to claims 17 or 18, in which two members each have a guiding surface in contact with a guiding surface of the other.

20. A mechanical transmission coupling according to claims 17, 18 or 19, in which the guiding means guides only one pair of members, the ridges or tooth-like projections of which members are in meshing engagement.

21. A mechanical transmission coupling according to claims 17, 18 or 19, in which the guiding means guides a plurality of pairs of members in meshing engagement.

22. A mechanical transmission coupling according to any of the claims 17 to 21 inclusive, in which a member is guided by more than one guiding means.

23. A mechanical transmission coupling according to any of the claims 17 to 22 inclusive, in which the guiding means is a rigid bar or block or the like.

24. A mechanical transmission coupling according to any of the claims 17 to 22 inclusive, in which the guiding means is a rigid assembly of parts.

25. A mechanical transmission coupling according to any of the claims 17 to 24 inclusive, in which friction reducing means of known kind, is introduced between a guiding surface of the guiding means and a guiding surface of a member to be guided, suitable friction reducing means being for example: linear ball or roller races, ball or roller bushes or slips, recirculating ball or roller races, bushes or slips with friction reducing surfaces or the like, singly, plurally or in any combination.

26. A mechanical transmission coupling according to any of the claims 17 to 25 inclusive, in which a guiding surface of the guiding means, is replaced by friction reducing means of known kind, such as for example: wheels, cylindrical ball or roller races or the like, linear ball or roller races or the like, singly, plurally or in any combination.

27. A mechanical transmission coupling according to any of the claims 8 to 26 inclusive, in which a guiding surface of a rectilinearly movable member is replaced by known friction reducing means, such as for example: cylindrical ball or roller races or the like, wheels or rollers, linear ball or roller races or the like, singly, plurally or in any combination.

28. A mechanical transmission coupling according to any of the preceding claims 1 to 27 inclusive, in which means is provided to limit the travel of a rectilinearly movable member in either or both of its directions of rectilinear movement.

29. A mechanical transmission coupling according to any of the preceding claims 1 to 28 inclusive, in which a member and or its guiding means is or are, respectively, provided with a detent means of known kind, to allow the separation and remeshing of a pair of meshing members to take place without subsequent adjustment of the position of the detained member, suitable known detent means being for example: a spring urged ball or roller or the like and a co-operating socket which is located at the detent position.

30. A mechanical transmission coupling according to any of the preceding claims 1 to 29 inclusive, in which a guiding means is provided with suitable means for its attachment to an external machine element, suitable means for attachment being for example: a threaded or plain hole or the like, a threaded or plain spigot or the like, a key or a pin or the like, or any other known means, singly, plurally or in any combination.

DAVID THOMAS CODD,

12, Thorncliffe Road,
Oxford,
OX2 7BB.

Printed for Her Majesty's Stationery Office by The Tweeddale Press Ltd., Berwick-upon-Tweed, 1974.
Published at the Patent Office, 25 Southampton Buildings, London, WC2A 1AY, from which copies may be obtained.

1381114 COMPLETE SPECIFICATION
1 SHEET

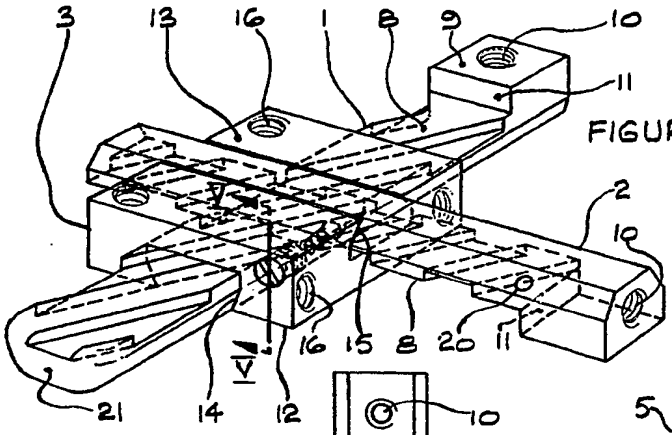

FIGURE: 1.

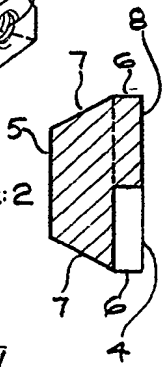

FIGURE: 2

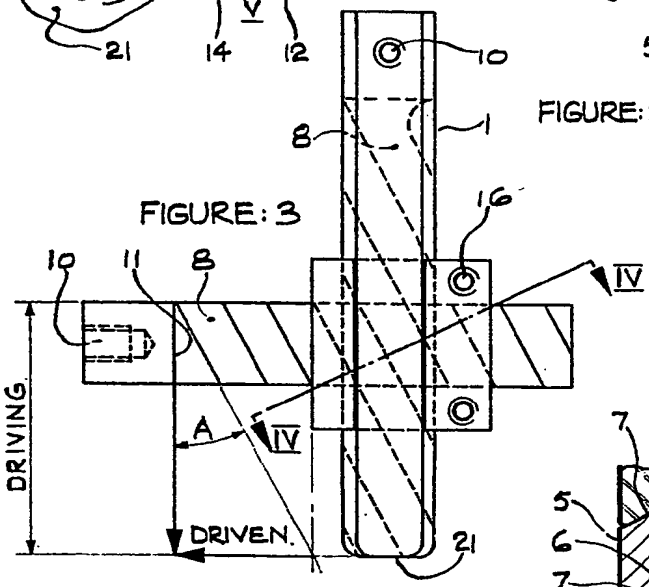

FIGURE: 3

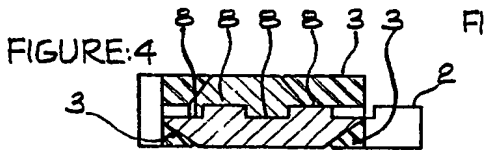

FIGURE: 4

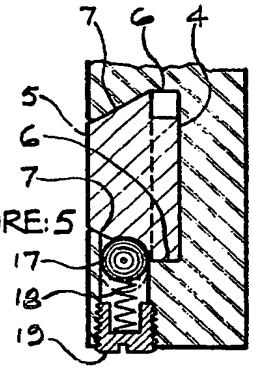

FIGURE: 5